



Standard Guide for Open-Path Fourier Transform Infrared (OP/FT-IR) Monitoring of Gases and Vapors in Air¹

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1. Scope

1.1 This guide describes active open-path Fourier transform infrared (OP/FT-IR) monitors and provides guidelines for using active OP/FT-IR monitors to obtain concentrations of gases and vapors in air.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

E 131 Terminology Relating to Molecular Spectroscopy²

E 168 Practice for General Techniques of Infrared Quantitative Analysis²

E 1421 Practice for Describing and Measuring Performance of Fourier Transform Mid-Infrared (FT-MIR) Spectrometers Level Zero and Level One Tests²

E 1655 Practices for Infrared, Multivariate, Quantitative Analysis²

3. Terminology

3.1 For definitions of terms relating to general molecular spectroscopy used in this guide refer to Terminology E 131. A complete glossary of terms relating to optical remote sensing is given in Ref (1).³

3.2 Definitions:

3.2.1 *background spectrum, n*—a single-beam spectrum that does not contain the spectral features of the analyte(s) of interest.

3.2.2 *bistatic system, n*—a system in which the IR source is some distance from the detector. For OP/FT-IR monitoring, this implies that the IR source and the detector are at opposite ends of the monitoring path.

3.2.3 *monitoring path, n*—the location in space over which

concentrations of gases and vapors are measured and averaged.

3.2.4 *monitoring pathlength, n*—the distance the optical beam traverses through the monitoring path.

3.2.5 *monostatic or unistatic system, n*—a system with the IR source and the detector at the same end of the monitoring path. For OP/FT-IR systems, the beam is generally returned by a retroreflector.

3.2.6 *open-path monitoring, n*—monitoring over a path that is completely open to the atmosphere.

3.2.7 *parts per million meters, n*—the units associated with the quantity path-integrated concentration and a possible unit of choice for reporting data from OP/FT-IR monitors because it is independent of the monitoring pathlength.

3.2.8 *path-averaged concentration, n*—the result of dividing the path-integrated concentration by the pathlength.

3.2.8.1 *Discussion*—Path-averaged concentration gives the average value of the concentration along the path, and typically is expressed in units of parts per million (ppm), parts per billion (ppb), or micrograms per cubic meter ($\mu\text{g m}^{-3}$).

3.2.9 *path-integrated concentration, n*—the quantity measured by an OP/FT-IR monitor over the monitoring path. It has units of concentration times length, for example, ppm·m.

3.2.10 *plume, n*—the gaseous and aerosol effluents emitted from a stack or other pollutant source and the volume of space they occupy.

3.2.11 *retroreflector, n*—an optical device that returns radiation in directions close to the direction from which it came.

3.2.11.1 *Discussion*—Retroreflectors come in a variety of forms. The retroreflector commonly used in OP/FT-IR monitoring uses reflection from three mutually perpendicular surfaces. This kind of retroreflector is usually called a cube-corner retroreflector.

3.2.12 *single-beam spectrum, n*—the radiant power measured by the instrument detector as a function of frequency.

3.2.12.1 *Discussion*—In FT-IR absorption spectrometry the single-beam spectrum is obtained after a fast Fourier transform of the interferogram.

3.2.13 *synthetic background spectrum, n*—a background spectrum made by choosing points along the envelope of a single-beam spectrum and fitting a series of short, straight lines or a polynomial function to the chosen data points to simulate the instrument response in the absence of absorbing gases or vapors.

¹ This guide is under the jurisdiction of ASTM Committee E13 on Molecular Spectroscopy and is the direct responsibility of Subcommittee E13.03 on Infrared Spectroscopy.

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² *Annual Book of ASTM Standards*, Vol 03.06.

³ The boldface numbers in parentheses refer to a list of references at the end of this guide.